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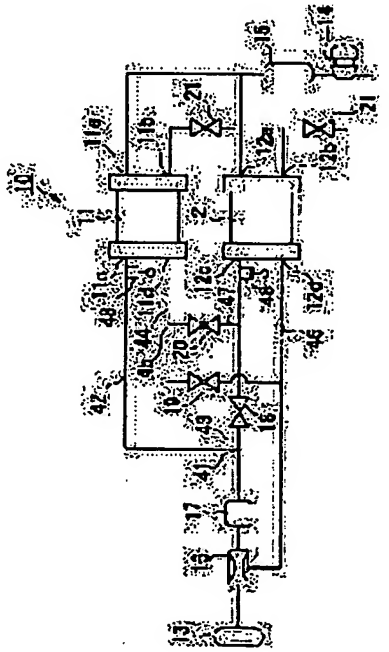
(54) FUEL CELL DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To make a fuel cell maintain a predetermined wet state by humidifying reaction gas supplied to the fuel cell, even if the output of the fuel cell is relatively low.
SOLUTION: The fuel cell device 10 is constituted with two or more fuel cell stacks 11, 12, fuel gas flow paths 42, 43 which supply the fuel gas in parallel to each the fuel cell stacks 11, 12, discharged gas flow paths 44, 46 which discharge in parallel the discharged gas discharged from fuel electrodes of each the fuel cell stacks 11, 12, a connection flow way 47 which connects the discharge gas flow path 44, which is connected to the fuel cell stack 11, to the fuel gas flow way 43, which is connected to the fuel cell stack 12, and a first, second, and third change valves 18, 19, and 20 prepared in the fuel gas flow path 43, discharge gas flow path 44, and connection flow path 47. The fuel cell stack 11 is made to be a humidifier for humidifying the fuel gas by selecting opening-and-closing operations of the first, second, and third change valves 18, 19 and 20.



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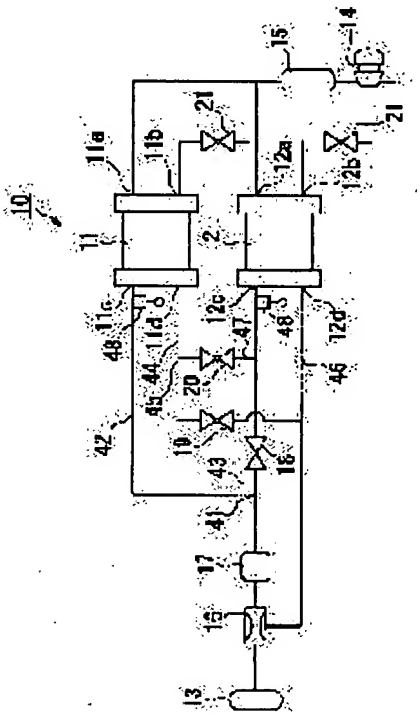

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Two or more fuel cell stacks to which it comes to carry out the laminating of two or more cels which put the solid electrolyte from both sides with the anode and the cathode, and were formed, The fuel gas passage which carries out juxtaposition supply of the fuel gas at the fuel electrode of two or more of said fuel cell stacks, The exhaust-gas passage which carries out juxtaposition derivation of the exhaust gas discharged from said fuel electrode, The connection passage which connects said exhaust-gas passage connected to said fuel gas passage connected to said fuel cell stack, and said other fuel cell stacks, Have two or more passage closing motion means formed in said fuel gas passage, said exhaust-gas passage, and said connection passage, and by selection of the switching action in said two or more passage closing motion means Fuel cell equipment characterized by using said at least one fuel cell stack as the humidifier for fuel gas humidification among said two or more fuel cell stacks.
[Claim 2] Said passage closing motion means is fuel cell equipment according to claim 1 characterized by choosing said switching action based on the moisture quantity of state of said fuel gas.
[Claim 3] It is fuel cell equipment according to claim 2 which is equipped with a humidification means to be established on said fuel gas passage and to supply water to said fuel cell, and is characterized by said passage closing motion means choosing said switching action according to whether the parameter about the humidification capacity of said humidification means exceeded the predetermined threshold.
[Claim 4] Said passage closing motion means is fuel cell equipment according to claim 3 characterized by choosing said switching action based on the amount of output states of one of said fuel cell stacks.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel cell equipment which used for example, the solid-state poly membrane as an electrolyte membrane, and relates to the technique which humidifies a solid-state poly membrane especially.
[0002]
[Description of the Prior Art] A former and solid-state macromolecule membrane type fuel cell is the stack (in the following) constituted by carrying out the laminating of two or more cels to the cel which put the solid-state polyelectrolyte film from both sides with the anode and the cathode, and was formed. it is called a fuel cell stack. Have, hydrogen is supplied to an anode as a fuel, air is supplied to a cathode as an oxidizer, and the hydrogen ion generated by catalytic reaction in the anode passes the solid-state polyelectrolyte film, and moves even a cathode. With a cathode, oxygen and electrochemical reaction are caused and it generates electricity.
[0003] In order to maintain generating efficiency highly, it is necessary to maintain the solid-state polyelectrolyte film to a saturation moisture state, and to secure the function as an ion conductivity electrolyte membrane here. For this reason, water is added to the reactant gas supplied to a fuel cell, such as hydrogen and oxygen, like the solid-state macromolecule membrane type fuel cell indicated by JP,8-273687,A, for example, and the fuel cell equipped with the humidification equipment which sets up highly the steam concentration in reactant gas (steam partial pressure) is known. In this fuel cell, when contacting reactant gas and an exhaust gas through a hollow fiber by making into humidification gas the exhaust gas (off-gas) discharged from a fuel cell, and the moisture contained in an exhaust gas penetrates **** of a hollow fiber and is spread as a steam in reactant gas, reactant gas is humidified.
[0004]
[Problem(s) to be Solved by the Invention] By the way, in case reactant gas is humidified, when using the exhaust gas discharged from a fuel cell as humidification gas like the solid-state macromolecule membrane type fuel cell concerning an example of the above-mentioned conventional technique, the steam partial pressure in an exhaust gas needs to be set up highly. Here, when the output of a fuel cell is relatively high, while water is generated by the electrochemical reaction by the side of the cathode of a fuel cell, when the generated water is spread from a cathode side to an anode side, the balance of a humidification condition is maintained at the anode and cathode side by the predetermined condition, and the exhaust gas of highly humid ** is relatively discharged from an anode and cathode side. By however, the thing which the amount of the water generated by the cathode side of a fuel cell will decrease if the output of a fuel cell becomes low relatively, for example While the amount of the water diffused from a cathode side to an anode side decreases, the inside of the solid-state polyelectrolyte film from a child's water carrying out orientation several minutes, and moving in connection with the hydrogen ion which moves to a cathode side, from an anode side Especially, the humidification condition by the side of an anode falls, the steam partial pressure of the exhaust gas discharged from the anode side of a fuel cell falls, and the problem of it becoming impossible to use this exhaust gas effectively as humidification gas arises.
[0005] As opposed to such a problem, water is stored in the exterior of a fuel cell, and after humidifying by carrying out bubbling of the reactant gas into this water, the approach equipped with the humidification equipment supplied to a fuel cell is learned. However, when it has such humidification equipment, while fuel cell equipment is enlarged, the problem that the structure of fuel cell equipment and control will be complicated

arises. This invention was made in view of the above-mentioned situation, and it humidifies reactant gas, without having humidification equipment for humidifying the reactant gas supplied to a fuel cell, even if it is the case that the output of a fuel cell is relatively low etc., and it aims at offering the fuel cell equipment which can maintain the solid-state polyelectrolyte film of a fuel cell to a predetermined damp or wet condition.
[0006]
[Means for Solving the Problem] In order to attain the purpose which solves the above-mentioned technical problem and starts, the fuel cell equipment of this invention according to claim 1 Two or more fuel cell stacks to which it comes to carry out the laminating of two or more cels which put the solid electrolyte from both sides with the anode and the cathode, and were formed (for example, fuel cell stacks 11 and 12 in the operation gestalt mentioned later), The fuel gas passage which carries out juxtaposition supply of the fuel gas at the fuel electrode of two or more of said fuel cell stacks (for example, fuel gas passage 42 and 43 in the operation gestalt mentioned later), The exhaust-gas passage which carries out juxtaposition derivation of the exhaust gas discharged from said fuel electrode (for example, exhaust-gas passage 44 and 46 in the operation gestalt mentioned later), Said fuel gas passage connected to said fuel cell stack (for example, fuel cell stack 12 of another side in the operation gestalt mentioned later) (For example, the fuel gas passage 43 in the operation gestalt mentioned later), and said other fuel cell stacks (-- for example, while was connected to fuel cell stack 11) in the operation gestalt mentioned later -- said -- exhaust-gas passage The connection passage to connect (for example, connection passage 47 in the operation gestalt mentioned later), (For example, exhaust-gas passage 44 in the operation gestalt mentioned later) Two or more passage closing motion means formed in said fuel gas passage, said exhaust-gas passage, and said connection passage (For example, the 1st, 2nd, and 3rd selector valves 18, 19, and 20 in the operation gestalt mentioned later) Have and by selection of the switching action in said two or more passage closing motion means It is characterized by using as the humidifier for fuel gas humidification said at least one fuel cell stack (while fuel cell stack [in / for example, / the operation gestalt mentioned later] 11) among said two or more fuel cell stacks.
[0007] When generating electricity by carrying out juxtaposition supply of the fuel gas at two or more fuel cell stacks according to the fuel cell equipment of the above-mentioned configuration For example, when the output required of fuel cell equipment is set up low relatively, while suspending the generation of electrical energy by at least one fuel cell stack The fuel gas passage for supplying fuel gas to the fuel cell stack which generates electricity with a passage closing motion means as a closed state Furthermore, connection passage which connects the exhaust-gas passage of the fuel cell stack which suspended the generation of electrical energy, and the fuel gas passage of the fuel cell stack to generate is made into an open condition with a passage closing motion means. Thereby, first, the fuel gas supplied to two or more fuel cell stacks is supplied to the fuel cell stack by which the generation of electrical energy was suspended, and as the inside of these fuel cell stacks is bypassed so to speak, after passing, it is discharged as an exhaust gas from exhaust-gas passage. And the discharged exhaust gas is supplied to the fuel cell stack which generates electricity by carrying out branching etc. suitably, for example.
[0008] When the cathode side of a fuel cell stack is maintained at the damp or wet condition by the operation of the humidification equipment which adds water to the oxidant gas supplied to the cathode side of a fuel cell stack at this time etc., even if it is the idle state of a generation of electrical energy, the anode side of the solid-state polyelectrolyte film is humidified by the ion hydration effectiveness of the solid-state polyelectrolyte film which acts effectively. For this reason, even if the fuel gas supplied to the fuel cell stack by which the generation of electrical energy was suspended is dryness, it will be humidified through the solid-state polyelectrolyte film, and the exhaust gas of a damp or wet condition will be discharged from the fuel cell stack by which these generations of electrical energy were suspended. That is, so to speak, the fuel cell stack by which the generation of electrical energy was suspended can be diverted to some other purpose as a humidifier to fuel gas. In this way, since the exhaust gas of the discharged damp or wet condition is supplied to the fuel cell stack which generates electricity, it can maintain the solid-state polyelectrolyte film to a saturation moisture state, and can maintain generating efficiency highly.
[0009] Furthermore, with the fuel cell equipment of this invention according to claim 2, said passage closing motion means is characterized by choosing said switching action based on the moisture quantity of state (for example, relative humidity in the operation gestalt mentioned later) of said fuel gas. According to the fuel cell equipment of the above-mentioned configuration, according to the moisture condition, for example, humidity

and the amount of humidification, a dew-point, a water vapor pressure of fuel gas, etc., the switching action of each passage closing motion means is controlled. For example, when the relative humidity of the fuel gas supplied to a fuel cell becomes below a predetermined threshold (for example, 80%), fuel gas passage for supplying fuel gas to the fuel cell stack which performs fuel cell stacks other than the fuel cell stack which suspends a generation of electrical energy of at least one fuel cell stack among two or more fuel cell stacks, and by which the generation of electrical energy was suspended, i.e., a generation of electrical energy, is made into a closed state with a passage closing motion means. And connection passage which connects the exhaust-gas passage of the fuel cell stack which suspended the generation of electrical energy, and the fuel gas passage of the fuel cell stack to generate is made into an open condition with a passage closing motion means. In addition, in the condition that the relative humidity of the fuel gas supplied to a fuel cell exceeded the predetermined threshold (for example, 80%), when the output required of a fuel cell is set up greatly relatively, all fuel gas passage for carrying out juxtaposition supply of the fuel gas is made into an open condition with a passage closing motion means at a fuel cell stack, and all connection passage is made into a closed state with a passage closing motion means. Thereby, the humidification condition of the request to fuel gas can be secured, and the generation-of-electrical-energy condition of a fuel cell stack can be controlled appropriately.

[0010] Furthermore, the fuel cell equipment of this invention according to claim 3 It has a humidification means (for example, fuel humidification section 17 of another side in the operation gestalt mentioned later) to be established on said fuel gas passage and to supply water to said fuel cell. Said passage closing motion means It is characterized by choosing said switching action according to whether the parameter (for example, relative humidity of the fuel gas in the operation gestalt mentioned later) about the humidification capacity of said humidification means exceeded the predetermined threshold. When it has the humidification means used in order to humidify fuel gas, for example in the time of starting of a fuel cell etc. according to the fuel cell equipment of the above-mentioned configuration, according to the parameter about the humidification capacity of this humidification means, for example, the humidity and the amount of humidification of fuel gas, a dew-point, a water vapor pressure, etc., the switching action of each passage closing motion means is controlled. Thereby, the desired amount of humidification is securable to fuel gas.

[0011] Furthermore, with the fuel cell equipment of this invention according to claim 4, said passage closing motion means is characterized by choosing said switching action based on the amount of output states of one of said fuel cell stacks (for example, output in the operation gestalt mentioned later). In addition to the value of the parameter about the moisture condition of fuel gas, and the humidification capacity of a humidification means, according to the output state of a fuel cell stack, for example, output power etc., the switching action of each passage closing motion means is controlled by the fuel cell equipment of the above-mentioned configuration. Thereby, the output of the request to a fuel cell is securable, securing the desired amount of humidification to fuel gas.

[0012]

[Embodiment of the Invention] It explains referring to the fuel cell equipment ****** accompanying drawing concerning 1 operation gestalt of this invention hereafter. Drawing 1 is the block diagram of the fuel cell equipment 10 concerning 1 operation gestalt of this invention, and drawing 2 is the sectional side elevation of an ejector 16. The fuel cell equipment 10 by the gestalt of this operation is carried in cars, such as an electric vehicle, is equipped with the fuel cell stacks 11 and 12 of plurality (for example, two pieces), the fuel feed zone 13, the oxidizer feed zone 14, the oxidizer humidification section 15, an ejector 16, the fuel humidification section 17, the 1st selector valve 18, the 2nd selector valve 19, and the 3rd selector valve 20, and is constituted.

[0013] To the cel which put the solid-state polyelectrolyte film which consists for example, of solid-state polymer ion exchange membrane etc. from both sides with the anode and the cathode, and was formed, the fuel cell stacks 11 and 12 carry out the laminating of two or more cels, are constituted, and are equipped with the fuel electrode with which hydrogen is supplied as fuel gas, and the air pole to which the air which contains oxygen as oxidant gas is supplied. And the air supply openings 11a and 12a with which air is supplied from the oxidizer feed zone 14, and the air exhaust ports 11b and 12b equipped with the air exhaust valve 21 for discharging the air in an air pole outside are formed in the air pole. On the other hand, the fuel feed hoppers 11c and 12c to which hydrogen is supplied from the fuel feed zone 13, and the fuel exhaust ports 11d and 12d for discharging the hydrogen in a fuel electrode outside are formed in the fuel electrode.

[0014] The oxidizer feed zone 14 consists of an air compressor, is controlled according to the input signal from

the load and accelerator pedal (illustration abbreviation) of the fuel cell stacks 11 and 12 etc., and supplies air to the air pole of the fuel cell stacks 11 and 12 through the oxidizer humidification section 15. After the oxidizer humidification section 15 mixed and humidified the steam to the air supplied from the oxidizer feed zone 14, it was supplied to the fuel cell stacks 11 and 12, and it has secured the ion conductivity of a solid-state molecule electrolyte membrane.

[0015] The ejector 16 is formed in the passage which connects the fuel feed zone 13 and the fuel humidification section 17. As shown in drawing 2 , an ejector 16 is equipped with body of ejector 16a, the fluid feed hopper 31, a secondary flow installation tube 32, the fluid exhaust pipe 33, a nozzle 34, and the sub** room 35, and is constituted. The sub** room 35 which consists of approximate circle column-like space is formed in Axis O and the same axle, the secondary flow installation tube 32 extended in the direction which intersects perpendicularly with Axis O at this sub** room 35 is connected to the interior of body of ejector 16a, opening of the end of a secondary flow installation tube 32 is carried out to it on the inner skin of the sub** room 35, and opening of the other end is carried out to it on the external surface of body of ejector 16a.

[0016] In the direction which met the axis O of an ejector 16, the approximately cylindrical nozzle 34 has projected on Axis O and the same axle from one internal surface of the sub** room 35, and it is arranged so that the point of this nozzle 34 may approach the internal surface of another side of the sub** room 35. The fluid feed hopper 31 which carried out opening on the external surface of body of ejector 16a is formed in the end face section of a nozzle 34, and the nozzle 34 has the inner skin of the shape of a taper whose diameter was gradually reduced toward the point from the end face section. And on the internal surface of another side of the sub** room 35, the end of the fluid exhaust pipe 33 which penetrates body of ejector 16a along the direction of axis O is carrying out opening, and opening of the other end of the fluid exhaust pipe 33 is carried out on the external surface of body of ejector 16a.

[0017] Fuel gas is supplied to the fluid feed hopper 31 of an ejector 16 from the fuel feed zone 12 shown in drawing 1 , and the exhaust gas discharged from the fuel exhaust ports 11d and 12d of fuel cells 11 and 12 is introduced into the secondary flow installation tube 32. Here, it is accelerated in the process in which a nozzle 34 is passed, and near the fuel style of the high speed emitted in the sub** room 35 toward the fluid exhaust pipe 33 from the point of a nozzle 34, the fuel gas supplied from the fluid feed hopper 31 is taken into the fluid exhaust pipe 33, as the exhaust gas introduced in the sub** room 35 from the secondary flow installation tube 32 is drawn in the style of [high-speed] a fuel. As negative pressure occurs in the sub** room 35 and this negative pressure is compensated in connection with this, an exhaust gas is attracted from a secondary flow installation tube 32.

[0018] The fuel gas and the exhaust gas which were mixed with the ejector 16 are discharged from the fluid exhaust pipe 33, and are supplied to the fuel humidification section 17. That is, the exhaust gas discharged from the fuel cell stacks 11 and 12 is circulated through an ejector 16. After the fuel humidification section 17 mixes a steam to the fuel gas supplied from the fuel feed zone 13 in the time of starting of fuel cell equipment 10 etc. and humidifies fuel gas, it supplied fuel gas to the fuel cell stacks 11 and 12 through the passage tee 41, and has secured the ion conductivity of the solid-state polyelectrolyte film.

[0019] The 1st selector valve 18 is formed in one fuel gas passage 43 among the fuel gas passage 42 and 43 which connects the passage tee 41 and each fuel feed hoppers 11c and 12c of the fuel cell stacks 11 and 12. Furthermore, the 2nd selector valve 19 is formed in the exhaust-gas passage 44 connected to 11d of fuel exhaust ports of one fuel cell stack 11, and the outflow way tee 45 is formed between 11d of fuel exhaust ports, and the 2nd selector valve 19. In addition, the exhaust-gas passage 44 of one fuel cell stack 11 is connected with the exhaust-gas passage 46 of the fuel cell stack 12 of another side on the lower stream of a river of the outflow way tee 45.

[0020] And the connection passage 47 which connects the exhaust-gas passage 44 connected to 11d of fuel exhaust ports of one fuel cell stack 11 and the fuel gas passage 43 of the fuel cell stack 12 of another side is formed through the outflow way tee 45, and the 3rd selector valve 20 is formed in the connection passage 47. In addition, the fuel gas passage 43 and the connection passage 47 are connected between fuel feed hopper 12c of the fuel cell stack 12 of another side, and the 1st selector valve 18. Moreover, the location each fuel feed hopper 11c and near the 12c is equipped with the dew-point instruments 48 and 48 which detect the dew-point of fuel gas in the fuel gas passage 42 and 43 to the fuel cell stacks 11 and 12.

[0021] The fuel cell equipment 10 by the gestalt of this operation is explained having the above-mentioned

configuration, next referring to an accompanying drawing about actuation of this fuel cell equipment 10. Drawing 3 is drawing usually showing the flow of the reactant gas in the fuel cell equipment 10 at the time of operation. Drawing 4 is drawing showing the flow of the reactant gas in the fuel cell equipment 10 at the time of humidification control. Drawing 5 and drawing 6 are flow charts which show actuation of fuel cell equipment 10. Drawing 7 is drawing showing change actuation of each selector valves 18, 19, and 20 at the time of usually shifting to humidification control from operation. Drawing 8 is drawing showing change actuation of each selector valves 18, 19, and 20 at the time of usually shifting to operation from humidification control, and drawing 9 is drawing showing change of the dew-point of the fuel gas supplied to the fuel cell stack 11 by which the generation of electrical energy was suspended, and oxidant gas.

[0022] First, when the humidification control which fuel cell equipment 10 mentions later at the usual operation time that is, is "OFF", as shown in drawing 3 , juxtaposition supply of the fuel gas is carried out to each fuel cell stacks 11 and 12 through the passage tee 41, and after the exhaust gas discharged from each fuel cell stacks 11 and 12 is made to join, recycling of it is carried out toward each fuel cell stacks 11 and 12 through an ejector 16. That is, as shown, for example in drawing 7 , in the condition of "OFF", fuel gas is supplied to one fuel cell stack 11 through the fuel gas passage 42, humidification control gets down, and fuel gas is supplied to the fuel cell stack 12 of another side, the 1st selector valve 18 prepared in the fuel gas passage 43 being used as a "open" condition. Furthermore, the 2nd selector valve 19 prepared in the lower stream of a river of the outflow way tee 45 in the exhaust-gas passage 44 of one fuel cell stack 11 is made into a "open" condition, and let the 3rd selector valve 20 prepared in the connection passage 47 which connects the exhaust-gas passage 44 of one fuel cell stack 11, and the fuel gas passage 43 of the fuel cell stack 12 of another side be "close."

[0023] On the other hand, when humidification control is "ON", as shown in drawing 4 , the fuel gas which branched through the passage tee 41 is supplied only to one fuel cell stack 11, and the exhaust gas discharged from this fuel cell stack 11 is supplied to the fuel cell stack 12 of another side. That is, as shown, for example in drawing 7 , in the condition of "ON", fuel gas is supplied to one fuel cell stack 11 through the fuel gas passage 42, humidification control gets down, and the 1st selector valve 18 prepared in the fuel gas passage 43 is made into the "close" condition to the fuel cell stack 12 of another side. Furthermore, the 2nd selector valve 19 prepared in the lower stream of a river of the outflow way tee 45 in the exhaust-gas passage 44 of one fuel cell stack 11 is made into a "close" condition, and let the 3rd selector valve 20 prepared in the connection passage 47 which connects the exhaust-gas passage 44 of one fuel cell stack 11, and the fuel gas passage 43 of the fuel cell stack 12 of another side be "open." Thereby, the exhaust gas discharged from one fuel cell stack 11 is supplied as fuel gas to the fuel cell stack 12 of another side, without circulating to an ejector 16 directly.

[0024] Here, the exhaust gas discharged from the fuel cell stack 11 which the generation of electrical energy is performed in each fuel cell stacks 11 and 12 by which juxtaposition supply of the fuel gas is usually carried out at the time of operation, and, on the other hand, suspends a generation of electrical energy in the fuel cell stack 11 to which fuel gas is supplied at the time of humidification control, and by which this generation of electrical energy was suspended generates electricity in the fuel cell stack 12 of another side supplied as fuel gas. Thereby, even if it is the case where the humidification condition that the humidification condition of fuel gas is required from each fuel cell stacks 11 and 12 cannot be fulfilled etc., one fuel cell stack 11 is used by humidification control as a humidifier which humidifies fuel gas so to speak, and the exhaust gas humidified in this fuel cell stack 11 is supplied to the fuel cell stack 12 of another side which generates electricity as fuel gas.

[0025] That is, the fuel gas supplied to two or more fuel cell stacks 11 and 12 is first supplied to the fuel cell stack 11 by which the generation of electrical energy was suspended, and as the inside of this fuel cell stack 11 is bypassed so to speak, after passing, it is discharged as an exhaust gas from the exhaust-gas passage 44. And the discharged exhaust gas is supplied to the fuel cell stack 12 which generates electricity. At this time, the cathode side of the fuel cell stack 11 by which the generation of electrical energy was suspended is maintained at the damp or wet condition by the oxidant gas humidified in the oxidizer humidification section 15 being supplied. Then, even if it is the idle state of a generation of electrical energy, the anode side of the solid-state polyelectrolyte film is humidified by the ion hydration effectiveness of the solid-state polyelectrolyte film which acts effectively. For this reason, even if the fuel gas supplied to the fuel cell stack 11 by which the generation of electrical energy was suspended is dryness, it will be humidified through the solid-state polyelectrolyte film, and the exhaust gas of a damp or wet condition will be discharged from the fuel cell stack 11 by which this generation of electrical energy was suspended. That is, so to speak, the fuel cell stack 11 by

which the generation of electrical energy was suspended can be diverted to some other purpose as a humidifier to fuel gas.

[0026] Therefore, when the damp or wet condition of the fuel gas supplied to each fuel cell stacks 11 and 12 cannot fill the predetermined amount of humidification demanded from each fuel cell stacks 11 and 12 while generating electricity by the fuel cell stacks 11 and 12 so that it may mention later, a generation of electrical energy of one fuel cell stack 11 is suspended, and it diverts as a humidifier. Namely, fuel gas can be humidified by the ion hydration effectiveness of the solid-state polyelectrolyte film in the process in which the fuel cell stack 11 by which the generation of electrical energy was suspended is passed, and can secure now only the damp or wet condition with which the predetermined amount of humidification demanded from the fuel cell stack 12 which generates electricity is filled. In this way, by the fuel gas humidified in the fuel cell stack 11 by which the generation of electrical energy was suspended being supplied to the fuel cell stack 12 which generates electricity, the solid-state polyelectrolyte film of the fuel cell stack 12 can be maintained to a saturation moisture state, and generating efficiency can be maintained highly.

[0027] For example, as shown in drawing 9 , to the fuel cell stack 11 by which the generation of electrical energy was suspended, the air (75 degrees C of for example, dew-points) humidified in the oxidizer humidification section 15 from air supply opening 11b by the side of a cathode is supplied, and the fuel gas in the condition of not humidifying is supplied from fuel feed hopper 11c by the side of an anode. Here, the air (10 degrees C of for example, dew-points) to which the humidification condition fell from air exhaust port 11a by the side of a cathode is discharged because the air humidified in the fuel cell stack 11 maintains the cathode side of the solid-state polyelectrolyte film to a damp or wet condition. At this time, in connection with the anode side of the solid-state polyelectrolyte film being humidified by the ion hydration effectiveness of the solid-state polyelectrolyte film, the fuel gas introduced in the fuel cell stack 11 in the state of no humidifying is humidified, and is discharged from 11d of fuel exhaust ports as an exhaust gas (75 degrees C of for example, dew-points) of a damp or wet condition.

[0028] The judgment processing for usually changing operation and humidification control to below is explained. First, in step S01 shown in drawing 5 , when juxtaposition supply of the fuel gas is usually carried out to each fuel cell stacks 11 and 12, for example at the time of operation, the moisture quantity of state of the dew-point instrument 48 prepared in the fuel gas passage 42 and 43 of each fuel cell stacks 11 and 12 and the fuel gas measured based on 48 grades, for example, relative humidity, judges whether it is below a predetermined threshold (for example, 80%). When this judgment result is "NO", it progresses to step S01, for example, operational status is usually maintained. On the other hand, when this judgment result is "YES", it progresses to step S02.

[0029] In step S02, the output of fuel cell equipment 10, i.e., the output from the fuel cell stacks 11 and 12, judges whether it is smaller than one half of the maximum output. When this judgment result is "YRS", it progresses to step S04 mentioned later. the case where this judgment result is "NO" on the other hand -- the output of fuel cell equipment 10 -- receiving (1/2) -- the acquired value (that is, an output/2) which carried out multiplication is set as a new output, and it progresses to step S04.

[0030] In step S04, as shown, for example in drawing 7 , the 1st selector valve 18 is made into a "close" condition, the 2nd selector valve is made into a "close" condition, and a series of processings are ended by making the 3rd selector valve into a "open" condition.

[0031] Next, it explains, referring to an accompanying drawing from the humidification control mentioned above about the processing usually changed to operational status. First, in step S10 shown in drawing 6 , it is in the condition of fulfilling the predetermined damp or wet condition as which the damp or wet condition of fuel gas is required from the fuel cell stacks 11 and 12, for example, and judges whether the output of fuel cell equipment 10 is equal to one half of the maximum output. When this judgment result is "NO", processing of step S10 is repeated. On the other hand, when this judgment result is "YES", it progresses to step S11. In step S11, as shown, for example in drawing 8 , the 1st selector valve 18 is made into a "open" condition, the 2nd selector valve is made into a "open" condition, and a series of processings are ended by making the 3rd selector valve into a "close" condition.

[0032] As mentioned above, when the air pole of one fuel cell stack 11 be maintained at the damp or wet condition by the oxidizer humidification section 15 which add water to the oxidant gas (air) supplied, for example to the air pole side of fuel cell equipment 10, even if it be the idle state of a generation of electrical

energy, according to the fuel cell equipment 10 by the gestalt of this operation, the anode side of the solid-state polyelectrolyte film be humidified by the ion hydration effectiveness of the solid-state polyelectrolyte film which act effectively. For this reason, the generation of electrical energy was suspended for while, even if the fuel gas supplied to the fuel cell stack 11 is dryness, it will be humidified through the solid-state polyelectrolyte film, and the exhaust gas of a damp or wet condition will be discharged from this fuel cell stack 11. That is, so to speak, the fuel cell stack 11 by which the generation of electrical energy was suspended can be diverted to some other purpose as a humidifier to fuel gas. In this way, since the exhaust gas of the discharged damp or wet condition is supplied to the fuel cell stack 12 of another side which generates electricity, it can maintain the solid-state polyelectrolyte film to a saturation moisture state, and can maintain generating efficiency highly.

[0033] In addition, in this operation gestalt mentioned above, although it judged whether the output of fuel cell equipment 10 would be smaller than one half of the maximum output when usually changing from the time of operation to humidification control, and it judged whether the output of fuel cell equipment 10 became equal to one half of the maximum output when usually changing from humidification control to operation, it is not limited to this but you may judge based on other values. Namely, it sets to the fuel cell equipment 10 which generates electricity by the fuel cell stack of plurality (for example, n pieces), and is a predetermined number (for example, k pieces.) at the time of humidification control. However, it considers as n>k. In using as a humidifier the fuel cell stack which suspends a generation of electrical energy of a fuel cell stack and by which the generation of electrical energy was suspended, it judges whether the output of the fuel cell equipment 10 at the time of operation is usually smaller than (maximum output x(n-k)/n). And when this judgment result is "NO", the value which carried out the multiplication of (n-k)/n and obtained it is set up as a new output to the output of fuel cell equipment 10.

[0034] In addition, in this operation gestalt mentioned above, although the change to operation and humidification control was usually performed based on relative humidity as a moisture condition of fuel gas, it is not limited to this, for example, the switching action of each selector valves 18, 19, and 20 may be controlled according to the moisture quantity of state of others, such as the amount of humidification, a dew-point, and a water vapor pressure. Furthermore, when the humidifier 17 is operating, for example in the time of starting of fuel cell equipment 10 etc., according to the parameter about the humidification capacity of a humidifier 17, for example, the humidity and the amount of humidification of fuel gas, a dew-point, a water vapor pressure, etc., the switching action of each selector valves 18, 19, and 20 may be controlled. Moreover, according to the output state of a fuel cell stack, for example, output power etc., the switching action of each selector valves 18, 19, and 20 may be controlled.

[0035]

[Effect of the Invention] As explained above, when the cathode of a fuel cell is maintained at the damp or wet condition according to the fuel cell equipment of this invention according to claim 1, even if it is the idle state of a generation of electrical energy, the anode side of the solid-state polyelectrolyte film is humidified by the ion hydration effectiveness of the solid-state polyelectrolyte film which acts effectively. For this reason, so to speak, the fuel cell stack by which the generation of electrical energy was suspended can be diverted to some other purpose as a humidifier to fuel gas, by supplying the exhaust gas of the discharged damp or wet condition to the fuel cell stack which generates electricity, the solid-state polyelectrolyte film can be maintained to a saturation moisture state, and generating efficiency can be maintained highly. Furthermore, according to the fuel cell equipment of this invention according to claim 2, the humidification condition of the request to fuel gas can be secured, and the generation-of-electrical-energy condition of a fuel cell stack can be appropriately controlled by controlling a passage closing motion means based on the relative humidity of fuel gas.

[0036] Furthermore, when it has the humidification means used in order to humidify fuel gas, for example in the time of starting of a fuel cell etc. according to the fuel cell equipment of this invention according to claim 3, according to the parameter about the humidification capacity of this humidification means, for example, the humidity and the amount of humidification of fuel gas, a dew-point, a water vapor pressure, etc., the switching action of each passage closing motion means is controlled. Thereby, the desired amount of humidification is securable to fuel gas. Furthermore, according to the fuel cell equipment of this invention according to claim 4, in addition to the value of the parameter about the moisture condition of fuel gas, and the humidification capacity of a humidification means, according to the output state of a fuel cell stack, for example, output power etc., the switching action of each passage closing motion means is controlled. Thereby, the output of the request

to a fuel cell is securable, securing the desired amount of humidification to fuel gas.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the fuel cell equipment concerning 1 operation gestalt of this invention.
[Drawing 2] It is the sectional side elevation of the ejector shown in drawing 1 .
[Drawing 3] Usually, it is drawing showing the flow of the reactant gas in the fuel cell equipment at the time of operation.
[Drawing 4] It is drawing showing the flow of the reactant gas in the fuel cell equipment at the time of humidification control.
[Drawing 5] It is the flow chart which shows actuation of fuel cell equipment.
[Drawing 6] It is the flow chart which shows actuation of fuel cell equipment.
[Drawing 7] Usually, it is drawing showing change actuation of each selector valve at the time of shifting to humidification control from operation.
[Drawing 8] It is drawing showing change actuation of each selector valve at the time of usually shifting to operation from humidification control, and is **.
[Drawing 9] It is drawing showing change of the dew-point of the fuel gas supplied to the fuel cell stack by which the generation of electrical energy was suspended; and oxidant gas.
[Description of Notations]
10 Fuel Cell Equipment
11 12 Fuel cell stack
17 Fuel Humidification Section (Humidification Means)
18 1st Selector Valve (Passage Closing Motion Means)
19 2nd Selector Valve (Passage Closing Motion Means)
20 3rd Selector Valve (Passage Closing Motion Means)
42 43 Fuel gas passage
44 46 Exhaust-gas passage
47 Connection Passage

[Translation done.]

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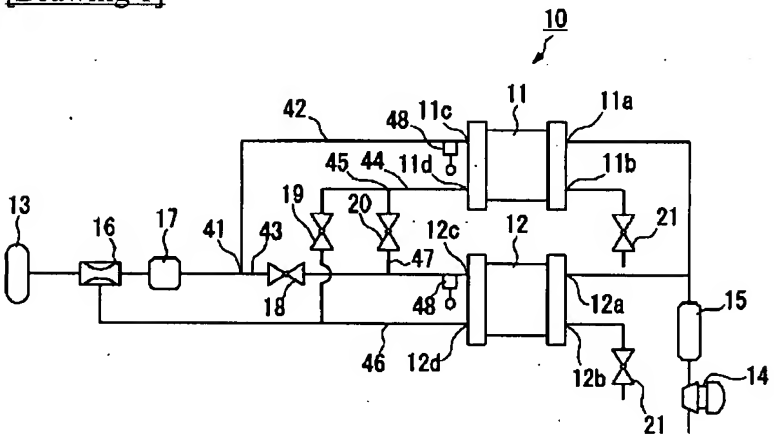
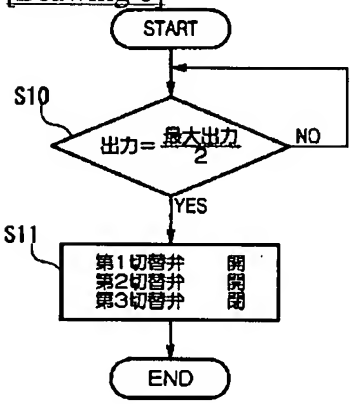
DRAWINGS

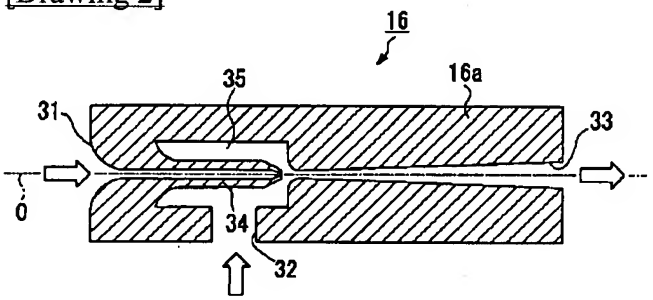
[Drawing 1]



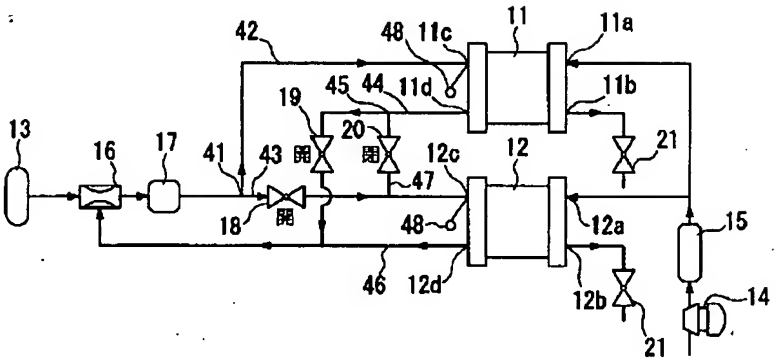
[Drawing 6]



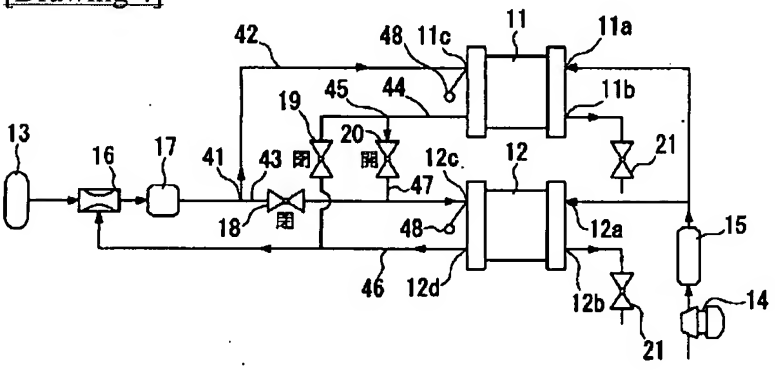
[Drawing 2]



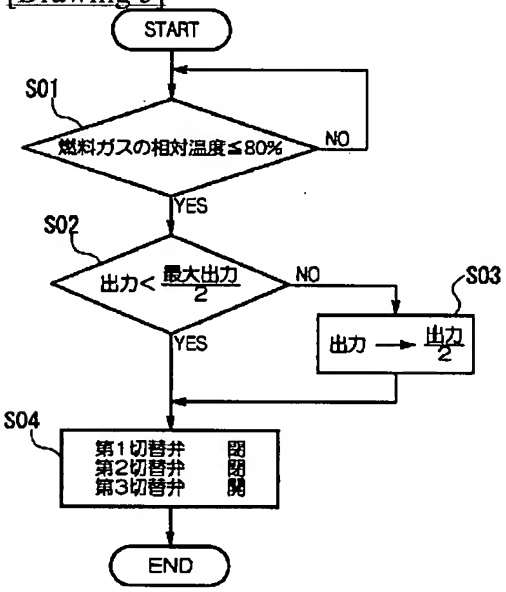
[Drawing 3]



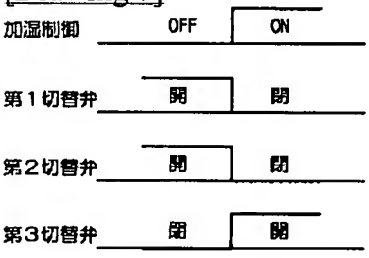
[Drawing 4]



[Drawing 5]



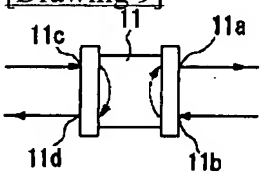
[Drawing 7]



[Drawing 8]

加湿制御	ON	OFF
第1切替弁	閉	開
第2切替弁	閉	開
第3切替弁	開	閉

[Drawing 9]



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